J. Jpn. Bot. **86**:120–123(2011)

Okihito YANO[a], Hiroshi IKEDA[a,*], Mark F. WATSON[b] and Keshab R. RAJBHANDARI[c]:

Dauciform Roots in *Carex atrofusca* Schkuhr subsp. *minor* (Boott) T. Koyama (*Cyperaceae*) from the Manaslu Himalaya, Central Nepal

[a]The University Museum, The University of Tokyo, 7-3-1, Hongo, Bunkyo-ku, Tokyo, 113-0033 JAPAN
[b]Royal Botanic Garden Edinburgh, 20a, Inverleith Row, Edinburgh EH3 5LR, Scotland, UK
[c]G. P. O. Box 9446, Kathmandu, NEPAL
*Corresponding author: h_ikeda@um.u-tokyo.ac.jp

Summary: Dauciform roots are reported for *Carex atrofusca* Schkuhr subsp. *minor* (Boott) T. Koyama (*Cyperaceae*) collected from the Manaslu Himalaya, Central Nepal. This is the first report of dauciform roots in *Cyperaceae* from the Himalayas.

Conical root clusters in *Cyperaceae* were first reported from the genus *Carex* in the Caucasus Mountains, Russia (Selivanov and Utemova 1969). A few years later Davies et al. (1973) found similar swollen lateral roots on 14 species in four European *Cyperaceae* genera, *Carex*, *Cladium*, *Kobresia*, and *Schoenus*. Powell (1973) also found similar swollen roots in the New Zealand sedge, *Schoenus* and *Uncinia*. Lamont (1974) reported such swollen roots in the Australian sedge *Cyathochaeta avenacea* (R. Br.) Benth., and named them 'dauciform roots'. Dauciform roots have subsequently been found in other European members of *Cyperaceae* in Europe (*Carex*: Harrington and Mitchell 2002), South Africa (*Tetraria*: Lambers et al. 2006), Australia (*Caustis*: Playsted et al. 2005, 2006, *Cyathochaeta*: Shane et al. 2005, *Gahnia*: Phillips and Weste 1984, *Lepidosperma*: Phillips and Weste 1984, Meney et al. 1993, Shane et al. 2005, Lambers et al. 2006, *Schoenus*: Shane et al. 2005), and Japan (*Carex*: Masaki and Hoshino 2009) (Table 1).

During the botanical expedition in the Manaslu Himalaya and adjacent areas, Central Nepal in 2008 (see Ikeda and Watson 2010), we collected *Carex atrofusca* Schkuhr subsp. *minor* (Boott) T. Koyama in the alpine region about 4130 meters above sea level. At that time, we found dauciform roots among the fibrous roots (Fig. 1A & B). This is the first report of dauciform roots in *Cyperaceae* from the Himalayas. The plant was growing on poor soil deposited between rocks on a slope where seasonal snow melt water flowed (Fig. 1C). Shane et al. (2005) demonstrated that dauciform roots could be formed under low phosphorous conditions. They suggested that dauciform roots might function in promoting absorption of phosphate or other microelements in oligotrophic soils. Masaki and Hoshino (2009) reported that two species of alpine *Carex* with dauciform roots grew on the poor ground, in similar conditions to where *C. atrofusca* subsp. *minor* grew in the Manaslu Himalaya. Thus, we agree with the hypothesis that dauciform roots of *Carex* in the alpine region are adaptations to growth under oligotrophic conditions.

Voucher specimen: C Nepal. Gandaki Zone, Gorkha District, Samagaon, around Birendra Kund, on the way to Manaslu Base Camp, 4130 m alt. (H. Ikeda & al. 20814087, 5 Aug. 2008, E, KATH,TI).

The authors extend their appreciation to Dr. L. R. Sharma, former Director of the Department of Plant Resources, Ministry of Forests and

Table 1. Taxon, locality and reference of *Cyperaceae* associated with dauciform roots

Taxon	Locality	Reference
Carex L.		
C. atrofusca Schkuhr subsp. *minor* (Boott) T. Koyama	Nepal	Present report
C. caryophyllea Latour.	Europe	Davies et al. (1973)
C. flacca Schreb.	Europe	Davies et al. (1973)
C. flava L.	Europe	Davies et al. (1973)
C. hostiana DC.	Europe	Davies et al. (1973)
C. lasiocarpa Ehrh.	Europe	Davies et al. (1973)
C. lepidocarpa Tausch	Europe	Davies et al. (1973)
C. panicea L.	Europe	Davies et al. (1973)
C. pilulifera L.	Europe	Harrington and Mitchell (2002)
C. rupestris All.	Japan	Masaki and Hoshino (2009)
C. sempervirens Vill.	Europe	Davies et al. (1973)
C. serotina Mérat	Europe	Davies et al. (1973)
C. stenantha Franch. & Sav.	Japan	Masaki and Hoshino (2009)
C. sylvatica Hudson	Europe	Davies et al. (1973)
Carex sp.	Russia	Selivanov and Utemova (1969)
Caustis R. Br.		
C. blakei Kük. ex S. T. Blake	Australia	Playsted et al. (2005, 2006)
Cladium P. Browne		
C. mariscus (L.) Pohl.	Europe	Davies et al. (1973)
Cyathochaeta Nees		
C. avenacea (R. Br.) Benth.	Australia	Lamont (1974)
Cyathochaeta sp.	Australia	Shane et al. (2005)
Gahnia J. R. Forst. & G. Forst.		
G. radula (R. Br.) Benth.	Australia	Phillips and Weste (1984)
Kobresia Willd.		
K. simpliciuscula (Wahlenb.) Mack.	Europe	Davies et al. (1973)
Lepidosperma Labill.		
L. gracile R. Br.	Australia	Meney et al. (1993)
L. laterale R. Br.	Australia	Phillips and Weste (1984)
L. squamatum Labill.	Australia	Lambers et al. (2006)
L. tenue Benth.	Australia	Shane et al. (2005)
Lepidosperma sp.	Australia	Shane et al. (2005)
Schoenus L.		
S. ferrugineus L.	Europe	Davies et al. (1973)
S. nigricans L.	Europe	Davies et al. (1973)
S. pauciflorus (Hook. f.) Hook. f.	New Zealand	Powell (1973)
S. subflavus Kük.	Australia	Shane et al. (2005)
S. unispiculatus Benth.	Australia	Shane et al. (2005)
Tetraria P. Beauv.		
Tetraria sp.	South Africa	Lambers et al. (2006)
Uncinia Pers.		
U. divaricata Boott	New Zealand	Powell (1973)

Fig. 1. Dauciform root of *Carex atrofusca* subsp. *minor*. A. Whole plant. B. Dauciform root. Arrow indicates dauciform root. C. Habitat.

Soil Conservation, Government of Nepal, for his guidance and assistance in conducting field research in Nepal. We also thank the members of the field trip in Nepal in 2008 for their help for collecting plant materials. This study was partly supported by a Grant-in-Aid for Scientific

Research (A), no. 18255004 in 2008 (to Hideaki Ohba, Professor Emeritus, the University of Tokyo) from the Japan Society for the Promotion of Science.

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矢野興一[a], 池田　博[a], M. F. ワトソン[b], K. R. ラジバンダリ[c]：**中央ネパール・マナスルヒマラヤ産 *Carex atrofusca* Schkuhr subsp. *minor* (Boott) T. Koyama（カヤツリグサ科）に形成されたニンジン型の根**

マナスルヒマラヤ（中央ネパール）に生育するスゲ属植物 *Carex atrofusca* subsp. *minor*（カヤツリグサ科）で，ニンジン型の根を発見した．カヤツリグサ科植物のニンジン型の根は , これまでに主にヨーロッパやオーストラリアなどで報告されていたが , ネパールヒマラヤ地域からの報告は今回が初めてである．ネパール産 *C. atrofusca* subsp. *minor* は，標高 4130 mの岩礫地に生育していた．*Carex atrofusca* subsp. *minor* のニンジン型の根は，岩礫地の貧栄養条件の土壌に生育していた結果 , 形成されたと考えられる．

（[a]東京大学総合研究博物館,
[b]エジンバラ王立植物園,
[c]ネパール・カトマンズ 私書箱 9446 号）